

Burden Iron Works (Burden Iron Company)
Between Wynants Kill and Burden Street, and
north of Wynants Kill along Hudson River
Troy, Rensselaer County,
New York

HAER NY-7

HAER
NY 42-TROY,
I.

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Office of Archeology and Historic Preservation
National Park Service
U. S. Department of the Interior
Washington, D. C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

BURDEN IRON WORKS (BURDEN IRON COMPANY)
HAER No. NY-7

Location: Between Wynants Kill and Burden Street; also north of Wynants Kill along the Hudson River. Troy, Rensselaer County, New York

Dates: 1809-1940

Present Owner: Burden blast furnace owned by Republic Steel Corporation.

Present use: Company liquidated in 1940.

Significance: An early giant of the United States iron industry, noted especially for the manufacture of horseshoes.

Historian: Samuel Rezneck, August 1969

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HISTORICAL INFORMATION

- A. Original and subsequent owners: The chain of titles for the land of the Upper (Water) Works is recorded in the Rensselaer County Recorder's Office. The office building is located, however, at the Lower (Steam) Works, site of the present blast furnace.

1808	Deed 8 January 1808 Vol. 4, page 456 Stephen Van Rensselaer to George Gardner and others
1823	Deed 13 October 1823 Vol. 11, page 140 Clarissa Adams and others to Troy Iron and Nail Factory Company
1847	Deed 6 April 1847 Vol. 67, page 110-111 William P. Van Rensselaer to Troy Iron and Nail Manufacturing Company

1852 Deed 12 August 1852
Vol. 83, page 463-469
William P. Van Rensselaer to
Henry Burden

The Burden Iron Company was liquidated in 1940 and the lower site acquired by the Republic Steel Corporation.

B. Corporate history of the Burden Iron Works (1809-1940)

One significant, small brick building remains on the site of what was once a great industrial complex located on the east side of the Hudson River in South Troy. It was built after the Civil War as an office building to serve the entire works which had developed over more than half a century.

The rest of what was once a vast and unique example of American heavy industry is gone after a long period of unsightly deterioration, and on its site now stands only a more modern blast furnace, that until recently operated somewhat irregularly as a subsidiary of the Republic Steel Corporation, and is now (1970) decommissioned permanently. How did the Burden Iron Company originate and develop over more than a century? What were its unique contributions both to Troy's growth and to the nation's industrial evolution? How and why did it come to an end? These are questions of broad social and human as well as technical and economic importance, and the answers to them comprise a vital part of the total record, supplementing the evidence of the single remaining building, which once contained the company business offices.

The birth of iron making in the Troy area occurred between 1807 and 1809, when Troy proper was barely two decades old. Two small iron plants were then erected on a water-power site along the Wynants Kill, as it tumbled down two hundred feet of cascades across a narrow littoral and into the Hudson River. This power had been used for grist and saw mills since the seventeenth century. Only Albany existed then as a settlement, and Troy was not founded until 1789. The capital for the early iron works came of necessity from Albany, but the power sites lay on Troy's side of the Hudson. Their products were primarily nails, spikes, and merchant or bar iron. One of these plants was established by John Brinkerhoff, and it ultimately developed into what was known as the Albany Iron Works, under the later ownership and management of Erastus Corning and John F. Winslow. These men played a large role in the growth of iron-making in this area, and during the Civil War joined with another Troy iron-maker, John A. Griswold, owner of the Rensselaer

Iron Works, in contracting for the construction of the Monitor and other iron-clads.* After the war they merged their interests and acquired the American rights to the Bessemer patents and constructed a Bessemer steel plant in South Troy, probably the first in the United States. This is a story by itself, deserving separate treatment. As a neighbor to Burden's on the Wynants Kill, the Troy Steel and Iron Company, as it was later known, thus grew out of a similar small beginning, and it contributed to the heavily industrial character of Troy during the nineteenth century.

The Burden industry originated in 1809, when several capitalists from Albany acquired a water-power on the Wynants Kill for the establishment of an iron works to manufacture bar iron, nail rods, hoop iron, and other metal products. A decade later it had become the Troy Iron and Nail Factory Company, with a capital of \$96,000, divided into sixteen shares. These were held by half a dozen men, among them the original founder, John Converse, E.F. Backus, Isaiah and John Townsend, and Col. Nathaniel Adams. One of Henry Burden's sons was later to be named after Isaiah Townsend. Col. Adams was the factory agent, and the small industrial village that had grown up about these iron works was called Adamsville.

Henry Burden came on this industrial scene a few years later, in 1822, as superintendent of the Troy Iron and Nail Factory. He had arrived in Albany only in 1819 as an immigrant mechanic, born in Dunblane, Scotland, in 1791. There he had received some training in drawing and engineering, and he brought with him recommendations from the United States Minister in Britain to Stephen Van Rensselaer, Thomas Benton, and John C. Calhoun. Van Rensselaer welcomed him to Albany, and for a time Burden engaged in the development of agricultural machinery, including an improved plow and an early cultivator. All of this was quite in line with Van Rensselaer's role as a great landlord and patron of science and practical technology, which led in 1824 to his foundation of the Rensselaer School in Troy to fulfill Amos Eaton's innovative program for the "application of science to the common purposes of life." This subsequently evolved into the present Rensselaer Polytechnic Institute.

Henry Burden devoted the rest of his life, from 1822 to his death in 1871, to the single-minded expansion of the

* The hull plates of the Monitor, built in Brooklyn, were rolled in Troy.

iron works until it became virtually his own creation, in name, ownership, and character. He passed on a greatly enlarged plant to his two surviving sons, James A. and I. Townsend, the first of whom displayed much of his father's inventive ability and directive capacity. It is noteworthy that, while the small beginnings of the Troy Iron and Nail Factory were the work of a group of men, the great growth of the Burden industrial complex was essentially the achievement of one man, Henry Burden himself.

Henry Burden's contribution was two-fold. In the first place, it was managerial. Burden displayed a great capacity both for internal management and for the required business relations with expanding domestic and foreign markets. In the second place, he was technically innovative, and became indeed one of the principal inventors in nineteenth century America. A painting of eminent American inventors in the 1860's shows Henry Burden in company with Eli Whitney, Robert Fulton, Samuel Morse, and other famous figures.

Burden's inventive career in the iron industry began early. By 1825 he had already patented a machine for making wrought-iron nails and spikes. This branch of manufacture, for which the plant had originally been established, continued to be important to the end, as the record will show. In 1835, however, Burden's inventive talent turned to a new area, the machine manufacture of horseshoes. This opened up a wholly new field of industry, for which Burden's became noted, and Troy was elevated to the horseshoe capital of the nation and of the world. Henry Burden made successive improvements for which he obtained patents in 1843, 1857, and 1862. The horseshoe machine was acclaimed as one of the technical marvels of the age, capable of turning out thirty-six hundred horseshoes per hour, complete from the iron bar to the finished shoe without the touch of a hand or external process.

The fame and use of this machine spread to Europe, and unhappily machine-made horseshoes facilitated the conduct of large-scale wars in Europe and America during the nineteenth century, from the Crimean and the Austro-Italian wars in the 1850's on, and particularly the American Civil War, in which the North enjoyed a great industrial advantage over the South. One of the principal objectives of southern raids was the seizure of Burden-made horse and mule shoes in northern supply stocks. Toward the end of the war, among a wild outpouring of southern plots centered in Canada, there was even one to secure designs of the horseshoe machine in Burden's Troy plant in order to

set up a factory in Atlanta. Sherman's capture of Atlanta frustrated the attempt.

In 1859, on one of his visits to Europe, Henry Burden arranged for the sale of the British rights to the horse-shoe machine to the Chillington Company. He noted, ironically, that the British product was to be advertised as "Burden's Hammered Horse and Mule Shoes," in which the word "hammered" replaced "machine." The process included the heavy blow of a hammer on each shoe, instead of its passing through a flattener, which Chillington contended would make the shoe "more straight," and "in addition tickling the fancy of the advocate of Hammering." With the European prejudice in favor of hand operations, advocacy of "machine" operations was "in no country of any benefit to the sale of the shoes." The object of this compromise was apparently to enable the British to enjoy the benefits of both worlds, machine-made as well as hand-made.

Burden's inventiveness seemed to have no bounds. In 1840 he patented what was probably his most significant contribution to the iron industry. This was the rotary concentric squeezer, which substituted mechanical squeezing for the forge hammer in converting the ball of puddled iron into blooms. It was acclaimed by the U.S. Commissioner of Patents as the first truly original American invention in iron-making. It also caught the fancy of British observers, who reported to Parliament in 1854 on the merits of the process. This invention, like others, became the subject of wide imitation and litigation in the industry generally. Burden derived the greatest benefits from his innovations by their effective exploitation in his own expanding plant rather than from the collection of royalties. Still another of Burden's inventions grew out of his combined mechanical skill and business perceptiveness. On one of his visits to England he had observed the shift from flat rails to "H" or "I" types. The latter required a different type of spike for nailing the rails down to the ties. The spike had to be bent or hook-headed, and in 1840 he developed a machine for its manufacture. Such spikes became a major product of the Burden Company, paralleling the expansion of railroads. It is noteworthy that Burden's iron manufactures met the needs of a kind of dual age, in which both the horse and the railroad were prominent. Interestingly, the hook-headed spike machine became the subject of a prolonged litigation between Burden and his industrial neighbor in South Troy, Corning and Winslow's Albany Iron Company. Initiated in 1842, the suit dragged on for a quarter of a century, from court to court, reaching the Supreme Court of the United States. It became a major cause célèbre of American business in the nineteenth century. Winning a vindication of his patent at great expense, Burden, however,

won meagre compensation for damages. A pamphlet of 1866 on the Burden case complained bitterly of the delays and costs of the law in America.

Although primarily preoccupied with the iron industry, Henry Burden applied his talents also to navigation and the development of marine steamboats. As early as 1833, he designed the "cigar boat," three hundred feet long, based on a cigar-shaped double hull and equipped with large paddlewheels. The first model, appropriately named Helen, after his wife, was accidentally sunk in the Hudson River. Burden continued, however, to have faith in the unusual concept. He boasted to his wife in 1842, in a letter from England, that Mr. Lardner, a famous technical publicist, had lectured on this boat in England, and "he assured me that nothing created such universal excitement throughout all Europe as did the notice of my boat." A few years later Burden advocated large steamers, of 15,000 tons, for the Atlantic crossing. The Great Eastern, launched by Brunel about a decade later, was a partial fulfillment of this proposal. In 1846, Burden became the promoter of "Burden's Atlantic Steam Ferry Company" which was established in Glasgow for the projected operation of large steamships. Perhaps fortunately, it did not materialize, and thereafter Burden was able to confine himself to his original enterprise, the Iron Works.

The invention of improved iron-making machinery punctuated the growth and success of Burden's career as an iron master. He regularly acquired more shares of the Troy Iron and Nail Company, until by 1835 he owned half of the stock. Most of his expanding financial interest in the business was received as compensation for the assignment to the firm of the rights to his iron machinery patents. By 1848 he was full owner of the works, which thereafter were corporately styled Henry Burden and Sons. In the meantime the works were steadily enlarged. Until the Civil War they were located on the slope of the hill above the Hudson River and were powered by Wynants Kill water. In 1851 they reached their greatest capacity when Burden designed and installed the "Niagara of Water Wheels," the most powerful, if not the largest in the world, to drive several trains of rolling mills. An overshot wheel with a capacity of 500 horsepower,* it was sixty feet in diameter and twenty-two feet wide. With its thirty-six buckets, each six feet three inches deep, it made two revolutions per minute. One of the industrial wonders of America, the Burden wheel inspired,

* The horsepower of the wheel is variously given as ranging from 500 to 1,000. Sweeny (see Sources of Information) in 1914 calculated it at 278 assuming a hydraulic efficiency of 84.25%.

among other things, a series of senior theses by students of nearby Rensselaer Polytechnic Institute, which were at once reverential and scientific in character. Even in its decaying state after abandonment about 1900, the wheel commanded interest as a sight to visit along with the Cohoes Falls on the Mohawk River across the Hudson River. A caption on a picture postcard of the wheel printed c. 1907 reflects the contemporary local sentiment, "... A movement was begun to take the wheel to pieces, but the Trojans desired that it be left standing as a monument to the skill and enterprise of him who had developed in their midst a most useful and powerful industry."

The Wynants Kill as a power source had the advantage of a steady flow of water from a chain of lakes to the east of Troy, but Burden further improved its regularity by developing a series of reservoirs in its lower stretches, including one on top of the hill overlooking the wheel. Long neglected, these reservoirs are now sluggish bodies of water choked with vegetation, a sad reminder of earlier, more useful days.

By the time of the Civil War the complex of structures known as the Upper or Water Works had reached its capacity, and still the demand for expansion grew. Beginning in 1862, a new complex of works was constructed on a forty-five acre farm lying between the railroad and the river. This was to be known as the Lower or Steam Works, as the blast furnace blowers and all of the other iron works machinery was driven by large steam engines. Coal, iron ore, and lime flux were brought in by rail and river. Burden, in fact, at that time acquired large tracts of land in Vermont, which contained ore and marble for flux. Materials came also from northern and eastern New York State.

The Burden firm thus became an early example of an integrated iron works, encompassing all stages of manufacture from raw materials to pig iron to finished products. A contemporary description of the works by Henry Burden's daughter, Margaret Burden Proudfit, in Henry Burden, Troy, 1904, provides a detailed account of this American industry, under one management, at its peak toward the end of the nineteenth century.

The little wooden mill which he [Burden] entered as a superintendent long ago disappeared to give place to his larger works, which today, were they to stand in one alignment, would occupy a tract of land a mile in length. This immense establishment comprises two works--the "upper works," or water-mills, on the Wynants Kill, a short distance

east of the Hudson river; and the new works, called the "lower works" or steam-mills, located on the "farm company" property, and the "Hoyle farm" embracing about forty-five acres of land between the Hudson River railroad and the river, extending from the Wynants Kill to the Clinton foundry.

The "upper works" embrace the following buildings:

- A rolling-mill and puddling forge, 358x136 feet.
- A horseshoe factory, two buildings, one 125x34 feet, and one 120x50 feet.
- A rivet factory, 120x80 feet.
- A horseshoe warehouse, semi-circular, 168x120 feet containing 16 large bins, in which can be stored 7,000 tons of horseshoes.
- A scraphouse and shop, 175x50 feet.

Here are also the general business office, a supply store, a rivet warehouse, the stables, etc.

The "lower works," or the new works, embrace the following structures:

- Two blast furnaces, each 65 feet high and 16 feet at their boshes, with two casting-houses, each 92x47 feet.
- Two stockhouses, each 114x65 feet.
- An engine-room, 85x50 feet.
- A puddling forge, 492x83 feet.
- A rolling-mill, 421x96 feet.
- A swaging shop, 271x45 feet.
- A punching shop, 253x45 feet.
- A horseshoe warehouse, 318x60 feet.
- A square building, containing offices, blow-room, etc., 96x96 feet.
- A machine shop, 140x57 feet.
- A blacksmith shop, 130x55 feet.
- A foundry, 250x57 feet.
- A pattern shop, 85x55 feet.
- A tin and plumbing shop, 64x55 feet.
- A building containing a supply store, draughting-room, laboratory, etc., 105x55 feet.
- An iron warehouse, 167x55 feet.

The erection of these works began in 1862, several buildings of which have been recently completed. This property has a river frontage of nearly a mile in extent, and an average elevation of eleven feet, being one foot higher than the track of the Hudson River railroad, east of it. The ground, before the erection of these great buildings, was low, and on account of periodical

freshets made dangerous to persons residing thereon. At great expense, these low grounds have been filled up and made valuable to the owners. The depth of water in the river adjacent to the works was shallow and full of bars, but by dredging, an average depth of about fourteen feet has been obtained and made H. Burden & Sons' dock accessible to the largest vessels plying on the upper Hudson.

ACRES OF MACHINERY

For the manufacturing purposes of these extensive mills a great amount of machinery is required. Could all the machines which are now in constant operation in these buildings be placed together in an open space of ground, it is more than likely that they would occupy more than a half score of acres of ground. Not to refer to their respective dimensions, the various classes of machinery found in the upper and lower works combined are the following:

- Sixty puddling furnaces.
- Twenty heating furnaces.
- Fourteen trains of rolls.
- Three rotary concentric squeezers.
- Nine horseshoe machines.
- Twelve rivet machines.
- Ten large and fifteen small steam engines
- Seventy boilers.
- One large water-wheel, already described.

In and about the building of the lower works is a net-work of railroad tracks, upon which daily are to be seen moving trains of cars conveying iron ore, kaolin, sand, stone, etc., to the different departments, or being loaded with horse-shoes and merchant-iron for distant purchasers. For shifting these cars from place to place, H. Burden & Sons own a locomotive, which is in constant requisition.

The steam derricks used for unloading coal from boats in the river, which attract so much of the attention of passengers on the passing steamboats, when going by the docks of the lower works, the invention of the late William F. Burden, are very ingenious contrivances, peculiar to these mills. Each one of these labor-saving appliances consists of two lofty wooden frames, placed one at the dock and the other at the rear of the coal-heap, some 300 feet distant. A strong wire cable is stretched

over these frames, on which an iron carriage travels to and fro, carrying a self-dumping iron bucket, which has a capacity for holding about a ton of coal. The power is furnished by a steam engine near the rear frame which hoists the bucket filled with coal from the boat to the cable and conveys it back to the point where is fastened the tilting apparatus that overturns its contents upon the pile.

Alongside of these mammoth heaps of coal are seen vast deposits of iron ore. These are chiefly brown hematite and the dark magnetic ore of Lake Champlain. Here, too, are piles of a fine quality of limestone, brought from Hudson, N.Y., which is used as "flux" to aid in the fusion of the ores.

THE ROMANCE OF MAKING HORSESHOES

The processes by which the mined iron ore is melted and moulded, the cast metal puddled and cut into small bars, these reheated and fashioned into long, narrow rods, to be passed to the horseshoe machines, are of peculiar interest to a spectator, and seem to him, like a dreamy romance, full of strange incidents and unthought-of dispositions. Step by step let him follow these different metallurgic operations, if he wishes to discover what are the secrets which are behind the smoky curtain that nature here places about these great furnaces and dusky forges. Entering the engine-room he inspects the admirable action of the two splendid engines, each of 250 horse-power, projecting a stream of air for the blast of the furnace; and here also are two Worthington pumps for supplying with water the boilers and other machinery of the mills. Here he sees the carefully kept hydro-metrical, thermometrical, and barometrical statistics, the number of the total "charges" of ore as regards their character and weight, the amount of coal and of limestone, the quality and the quantity of the pig-iron made, the pressure and the temperature of the blast, and other important data. The blast furnace that to him had a close resemblance to the high walls, strong towers and lofty battlements of an ancient castle, as he first viewed it from the windows of the cars on the Hudson River railroad, he now sees is a massive brick and stone structure, sixty feet

in height. Alongside of the extensive heaps of iron ore and limestone are groups of men filling handbarrows, which with their contents will soon be hoisted to the top of the furnace. Before doing this, the ore in the barrows is weighed. Stepping upon the platform of the "elevator," upon which have been run several of these barrows of ore and limestone, he soon is carried upward until the fuming breath of the heated furnace fills his nostrils and warns him of the internal fires raging within its capacious depths. Here he sees a chimney-like structure over the mouth of the furnace supported by six iron columns, each of which marks a division into which at set intervals a certain number of barrows of ore, limestone, and coal are dumped in order to keep the furnace filled evenly to its mouth. Through this great quantity of burning and melting material is a heated blast of air pouring night and day the year round, and the molten metal flowing down into the hearth below where it is tapped and run-off into the casting-house. Over the floor of this building is spread a covering of sand two or three feet deep, which is called "the pig-bed." Longitudinal trenches are made in this bed, which are termed "sows," from which at right angles are formed smaller trenches of "pigs." When the molten metal flows from the furnace it runs through and fills these trenches, where it slowly cools, and when taken out it is known as pig-iron.

THE WONDERS OF THE PUDDLING FORGE

The chemical elements of pig-iron are such as to render it unfit for any serviceable use in these mills, and it therefore undergoes another process of melting in the puddling furnaces, where it is subjected to currents of air and flame while agitated by tools in the hands of the puddler. This manipulation brings it in contact with oxygen, which drives out the carbon in the pig-iron, leaving the metal afterward in a decarbonized condition.

In this temple of Vulcan--the puddling forge--the visitor beholds a scene of stirring activity seldom witnessed elsewhere. Scattered in groups or dispersed singly through this spacious building are hundreds of brawny men, with faces bedewed with perspiration and begrimed with coal

dust, nude to their waists, their feet incased in heavy hob-nailed shoes, and their strong hands turning, thrusting, pulling, and piling the molten of fashioned iron in ways innumerable amid the heat, the smoke and the short-lived splendor of a thousand red-hot metallic sparks. Here are sooty-faced men stirring through the open doors of flaming furnaces, glowing incandescent masses of iron that blind one's eyes with their fervent brilliancy; others again are taking great balls of puddled metal from the furnaces in iron buggies and casting them into the devouring jaws of the rotary concentric squeezers, from which, as unpalatable morsels, they are ejected in the shape of compact blooms which are immediately taken up red-hot as they are, and thrust between a pair of revolving cylinders, placed one above the other, and furnished with grooves of various sizes through which the bloom is run forward and backward, until it is shaped into a long bar of crude iron. The bars which have already cooled are then carefully tested by placing the end of each one on an anvil, where it is cut and bent before it receives its classification. These are then carried on cars to a great pair of iron shears, where they are cut as if they were ribbon, into pieces about three feet in length. These pieces, a number of them called "a pile," are again placed in furnaces, where they are reheated and again taken out and passed through the roll trains, whence they issue, like long fiery serpents, in narrow bars, and passed to the horseshoe machines.

SIXTY HORSESHOES MADE IN A MINUTE

Watch this wonderful piece of mechanism at work, which in a second of time makes a horseshoe. Before you are two strong frames between which are four revolving shafts geared together and getting their motion from a pulley-wheel. On the shaft most exposed to view, you see three cams, one of which raises a cutting lever, another lifts a bending frame on which is a bending tongue, and the third works the flattening pieces. This shaft also gives motion to

the feed rollers. The center shaft revolves an iron wheel upon the periphery of which, at opposite points, are two iron dies to give form to the upper or concave side of the shoe,-- the side that is next to a horse's hoof. Another shaft in like manner revolves a die which gives form to the lower part of the shoe. These several dies are curved in form and "mash" into each other, at each revolution of the shafts. The shaft which carries the shaping apparatus has also two cams for working side levers which close in the heels of the shoe. The creasing shaft bears an iron block to which are attached the "creasers."

Observe now the rapid movements of these shafts and their appurtenances. Gliding like a fiery serpent, you see a red-hot bar of iron, moving toward the machine, on the feeding rollers. Already the iron jaws of the monster are opening to catch between its incisive teeth this glowing rib of iron. The end of the bar has passed to the opposite side of the ravenous automaton's mouth, which is the proper measurement of the length of the intended shoe-- the cutter comes up and severs it, and for an instant stops the feed; the bending tongue raises up and is pushed against the cut bar and bends it between two forked cams; it is then caught between the upper and lower dies, taking their impression, the bending tongue falls back, and the side levers close in the heel-ends. While yet upon the center shaft die, a partial revolution carries it against the creasing die, where it is creased and receives the indented marks for the nail-holes. A little farther around, it is taken from the lower die by two knives and falls down and is then carried by an endless chain of linked pieces of malleable iron to the punching-room. In the latter are seen a long line of men seated astride of the saddles of the punching machines making the nail-holes through the indented marks previously put in the creased part of the shoes. Thence they are conveyed in hand-cars to the swaging furnaces in which they are placed before they are swaged.

Boys are at work here, taking with tongs the heated shoes from the furnace and putting them singly on the revolving dies of the swaging

machine. After the heated shoe is seated upon one of these dies, it is carried to the top of the machine where it is stopped for a moment; a top die descends on it and two side steels swage the sides of the shoe, removing all bulges and making the outside edges of the shoe perfectly smooth; thence it is carried farther to the opposite side of the machine where there are two other side swedges which swedge up the heels of the shoe, thence it is carried beneath the machine where a wiper removes it from the die and the shoe falling upon an endless band of malleable plates is carried to the south end of the swaging shop where it is dropped off to cool and to be rigidly inspected before being transferred in hand cars to the bins of the shoe warehouse. The shoes when packed for shipping are then taken out, weighed and packed in kegs, in each of which are to be found 100 pounds of perfectly made horseshoes.

Above the lower openings of the great bins in the horseshoe warehouse are the printed names of the pattern and size of the different classes of shoes. There are three patterns of Burden's improved swaged horseshoes, namely, the light, medium, and heavy. As the visitor's eye glances along the long line of the bins, he sees the sizes marked as follows: Horseshoes "fore," Nos. 0, 1, 2, 3, 4, 5, 6, 7; and "hind" of the same sizes; mule shoes, Nos. 1, 2, 3, 4, 5.

SHOES FOR MORE THAN TWELVE MILLIONS OF HORSES

The stupendous manufacturing resources of H. Burden & Sons' establishment are really only comprehended by the visitor when he asks how many horseshoes the machines he has so intently watched produce annually. The answer that the works have a capacity for making 600,000 kegs, or about 51,000,000 shoes, is to him almost too amazing to be believed, and yet he has himself looked upon the practical evidences of this great power of production. The two warehouses, one at the upper and the other at the lower works, have storage capacity for more than 250,000 kegs. The nine horseshoe machines in use, which he has witnessed in their separate operations, can make sixty

shoes in a minute. As he pictures to himself this army of twelve millions of horses that can be annually shod with the shoes made at these works, he realizes the important and useful character of the wonderful machine designed by HENRY BURDEN. Where are these shoes sold? Everywhere throughout the United States and Canada. Here in the lower warehouse a visitor, a day or two ago, could have seen hundreds of these kegs filled with shoes, their marked destinations being San Francisco, Cal., and Portland, Oregon. These shoes for their excellence of quality and finish have a world-wide reputation, and this single establishment, to which Troy points with pride, manufactures more horseshoes than all the other works in the world put together. (Henry Burden, Troy, 1904, pp. 70-77.)

One can still picture these works spewing forth streams of smoke and soot over the whole of South Troy, which comprised a remarkable example of a nineteenth century industrial settlement, with grocery stores and saloons on almost every street corner. Even in their present quiescence, the surviving houses still bear the grime of an age of coal. Here were collected over the century the diverse components of the first wave of immigration that populated this country and filled its mills and shops with labor. There were the early families of Scottish, English, and Welsh mechanics, many brought over by Burden, who gave their name to Scotch Hill. More numerous were the Irish immigrants who occupied the streets and alleys in the valley below. To complete, as it were, the character of industrial feudalism which the whole possessed, there was the Woodside Presbyterian Church, built by Henry Burden in memory of his wife. Over all, on top of the hill, stood Woodside, the manorial house occupied by the master, Henry Burden, and his family.

At its peak, the Burden Iron Company employed more than 1400 men, with an annual output of 600,000 kegs containing more than fifty million horseshoes. It was the largest factory of its kind in the country, probably in the world. In addition, the Burden Company turned out vast quantities of railroad spikes, rivets, and other iron products. "Burden's Best" became a trade name for iron of high quality.

The vast complex of the Burden iron works, both as a productive mechanical plant and as a flourishing business organization, was largely the accomplishment of Henry

Burden himself during a dedicated lifetime between 1822 and 1871. It was soon thereafter troubled and even threatened with dissolution, although it survived another half a century before its final disintegration. The first source of difficulty was internal, deriving from interfraternal friction. There were only two surviving brothers of an original four, to whom the succession passed even before the father's death. They were James A. and I. Townsend Burden, who were quite different both temperamentally and in their suitability for industrial management. The older, James A., apparently inherited his father's mechanical as well as business skill, but I. Townsend, the younger son, was, however, more inclined to lead the life of a rich man's son in the nineteenth century, driving fine fast horses and traveling luxuriously and widely.

In the original partnership of Henry Burden and Sons, both sons owned equal shares and had independent as well as conflicting ideas on management. Friction was therefore inevitable and threatened the very partnership itself by 1881. What might have happened to the whole Burden business under these circumstances is problematical. For good or for ill, a way out was found in corporation and reorganization as the Burden Iron Company, which thus had a strange origin as an effort to cover over division in the family. Under it James, with a somewhat larger share of stock ownership, became president, and Townsend had to be content with a smaller interest and virtually no authority. The capitalization was \$2 million. Actual management was turned over to a third man, John L. Arts, who had worked at Burden's from boyhood. He became general manager on the ground, since both brothers were now away from Troy much of the year, living in New York City. Thus early did the Burden family dissociate itself from Troy and from the actual operation of the plant and direct it from a physical as well as social distance. In this absentee ownership and management undoubtedly was a source of early weakness in the Burden company, which had grown to greatness largely under the eye of a single man, who was at once owner, inventor, and manager, in the characteristic fashion of nineteenth century industry.

Even incorporation did not solve the problems of the Burden business. In 1889 I. Townsend entered suit against his brother James, to put the company under a receivership. The internal affairs and quarrels of the family were aired in open court during a prolonged hearing, and the proceedings were published in all

their lurid details. It came out for example that, after the father's death, the company had suffered decline and deterioration. The early patents for Burden's machines had expired, and competition in horseshoe manufacture had become intense to the detriment of the Burden business. Only James' mechanical ingenuity saved the day as a new improved swaging machine restored a kind of leadership in the horseshoe field. Also, the remote and expensive iron ore obtained in Vermont from lands acquired in the Civil War years was replaced by cheaper, better ore brought from the Adirondacks. The suit was dismissed since the company was now prospering and there was no cause.

The Burden Company acquired, as it were, a new lease on life and prosperity, and flourished for a few decades longer, despite continued friction between the brothers. Even the erection of an office building in 1881, an interesting example of nineteenth century business architecture and the principal surviving physical relic of this one-time iron company in Troy, was the source of disagreement. It is evident from this intra-family squabble that divided management was to remain a chief source of weakness in the Burden company, to which were added in due course technological stagnation and the changing geography and composition of the American iron industry, particularly after 1900, which left Troy behind as an iron center.

Consequently, gradual decline soon set in and spread out over half a century. Well before 1900 the upper water-works became uneconomical. It was eventually abandoned to a sad state of deterioration, including the slow ruin of the magnificent water wheel. Production was concentrated in the lower steam-works. Here too, changes became evident after 1900. Horseshoes, once the principal product, became a diminishing factor, although sold to the very end. As late as 1933 United States Army horses were still shod with Burden shoes. Nevertheless, a company catalogue of 1920 entitled Burden Iron, did not even mention horseshoes. Instead, it argued for the superiority of wrought or puddled iron, particularly of Burden quality, over steel, for many purposes. The principal products were now advertised as (boiler) stay and engine bolts, rivets and chain iron, and in addition to "Burden's Best", were lesser grades of merchant iron. In the modern age of steel it was not possible for Burden's manufacturing iron specialties alone to maintain the scale of operations developed in the nineteenth century.

The decline of Burden's was part of a general slow-down of Troy's role as an iron-making center. The steel works and other heavy metal establishments either suspended or were sharply curtailed as the pull of the West, with better access to coal, ore, and markets, asserted itself. As an older center of iron manufacture, Troy's technology and machinery tended toward obsolescence, and its labor was perhaps more turbulent and troublesome. Management too tended to become less driving and dynamic.

In this connection the role and association of the Burden family with this enterprise during its last phase are especially noteworthy. Henry Burden's sons, James A. and I. Townsend, continued to manage the works until their death. Both lived during their last years in New York City, and Woodside was only their address for occasional visits to Troy. James A. died in 1906 and I. Townsend in 1913. The last Burden president of the company was James A. Burden, Jr., who died in 1932. The family was now fully established in New York City, where its descendants have enjoyed social prominence.

In 1925 the Burden company ventured into a new field of activity, the Hudson Valley Coke and Product Corporation, located on the Burden site, for the manufacture of coke, gas, and pig iron. James A. Burden was chairman, with immediate direction in new, but changing, hands. It was not, however, very successful.

By 1934 the Burden Iron Company was in obvious difficulties and apparently in receivership. The Burdens were now listed as trustees, while William E. Millhouse, formerly the general superintendent, was both president and treasurer. The officers changed frequently, although a Burden appeared as a trustee until 1939, when even that remote connection was apparently severed. The Burden Iron Company was making desperate efforts to operate during those years of depression in reduced circumstances and to discover new products. Failure was impending, and by 1940 the company was in liquidation.

The Republic Steel Corporation acquired the Burden blast furnace, built in 1925, and has operated it since then. In November 1940 the Burden office building, except for the furnace and a few decrepit storage shed the lone survivor of this one-time vast plant, was emptied of its accumulation of company records. They were turned over to the Division of Manuscripts of the New York State Library in Albany for preservation. Thus ended the

long history of an industrial establishment which had been originally created in the infancy of Troy and of American industry. It had thrived for a century and then suffered decline for a generation longer. Its end was only part of a general process of decline which affected other industries in Troy, both metal and textile.

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August 1969

PROJECT INFORMATION

These records were prepared as part of the Mohawk-Hudson Area Survey, a pilot study for the Historic American Engineering Record which was established in 1969 under the aegis of the Historic American Buildings Survey. The project was sponsored jointly by the National Park Service (Historic American Buildings Survey), the Smithsonian Institution (National Museum of History and Technology), the American Society of Civil Engineers (National Headquarters and Mohawk-Hudson Section), and the New York State Historic Trust. The field work and historical research were conducted under the general direction of Robert M. Vogel, Curator of Mechanical and Civil Engineering, Smithsonian Institution; James C. Massey, Chief, Historic American Buildings Survey; and Richard J. Pollak, Professor of Architecture, Ball State University, Project Supervisor; and with the cooperation of the Department of Architecture, Tensselaer Polytechnic Institute.

HISTORICAL ADDENDUM

From THE AMERICAN CENTENARY by Benson J. Lossing.
Philadelphia, 1876. Pages 217-220. (Chapter XVIII)

THE BURDEN IRON WORKS

Henry Burden, a native of Scotland, and educated there in engineering and drawing, and who came to the United States in 1819, was the first inventor of a machine for making spikes. He settled in Troy, New York, where iron-works in which he became interested, had been established as early as 1813. Mr. Burden became connected with them in 1822, when they were owned and worked by an incorporated company under the name of the "Troy Iron and Nail Factory." The works were then small, but through the energy, industry and inventive genius of Henry Burden, they rapidly increased in importance. He was successively superintendent and agent of the works, and president of the Company. After many additions had been made to the establishment, the works were entirely re-built on a much larger scale.

Before his settlement in Troy, Mr. Burden had invented a plow and a cultivator. In 1825, he patented a machine for making ship-spikes which, up to that time, had been made by hand. On the same machines countersunk railroad spikes for flat rails were afterward made. About 1830, he invented a machine for making horse nails. In 1834, he was granted a patent for an improvement in the method of constructing steamboats and other vessels. The year before, he built at the Troy Iron Works a steamboat 300 feet in length with paddle-wheels 30 feet in diameter, which, on account of its shape, was called the "cigar boat." He anticipated the younger Brunel in advocating the construction of ocean steamships. In January, 1846, a prospectus of "Burden's Atlantic Steam Ferry Company" was issued at Glasgow, Scotland, in which it was declared that the present Atlantic steamers [of the Cunard line,] magnificent though they be, are as inferior in their results to what they may become, as a well appointed stage coach is to a railway train.

In 1840, Mr. Burden obtained a patent for a process of his invention for making "hook-headed" railroad spikes. He had used the process several years before the patent was granted. The same year he obtained a patent for a machine for rolling puddled iron balls, called the "Burden Rotary Squeezer," which caused important changes in the process of manufacturing iron throughout the world. At one time about three-fourths of all the puddled iron made on the earth, passed through these machines.

Mr. Burden's greatest invention was the machine for making horse-shoes, which was first patented in 1835. An improvement was patented in 1853; and in 1857 he obtained a patent for another horse-shoe machine, which was again improved and patented in 1862. As fast as Mr. Burden's inventions were perfected, they were put into operation in the works at Troy. In those works ship-spikes, hook-headed railroad spikes, and horse-shoe nails were first made by machinery. There Burden's Rotary Squeezer was first put in operation: and there horse-shoes were first successfully made by machinery.

From time to time Mr. Burden purchased stock in the Troy Iron and Nail factory, until the entire interest was finally acquired by him. His three sons, William F., James A. and I. Townsend Burden, whom he had educated to the business, were associated with him as partners. The business was largely increased. They purchased ore mines and lime-stone quarries--lime-stone quarries--[sic] acquired property in coal mines, and built on the river bank in the southern suburbs of Troy, new works far surpassing the old ones in magnitude and appointments. The name of the establishment was changed to Burden Iron Works, and the firm name became "Henry Burden and Sons." Mr. Burden died in January, 1871; his eldest son, William F. Burden, had died December 7, 1867. The works are now owned by the two surviving brothers, who retain the firm name of Henry Burden and Sons.

The old establishment called the "Upper Works," or "Water Mill" are in the valley of the Wyanterkill [sic], a short distance from the Hudson river. They consist of the following buildings: a rolling-mill and puddling forge under one roof in a brick building 358 by 136 feet; a horse-shoe factory in two buildings, which are 125 by 34 feet, and 120 by 50 feet respectively; a rivet factory 120 by 80 feet; a semi-circular horse-shoe ware-house 168 by 120 feet, divided into sixteen large bins capable of holding 7,000 tons of horse-shoes; scrap-house and shops 175 by 50 feet; the general office, supply store, ware-house for rivets and spikes, stables, et cetera. In these works is a celebrated overshot water-wheel, designed and built by Henry Burden, in 1851. It is 60 feet in diameter, and 22 feet in width. It has 36 buckets each six feet deep, and has a horse-power of 1200. It is believed to be the largest water-wheel in the world.

The "Lower Works," or "Steam Mills" are on the bank of the Hudson river, a short distance from the other works. There the Messrs. Burden own an extensive tract of land, with a river front of nearly a mile, affording ample room for receiving materials and shipping the products.

The Lower Works were built in 1862, and consist of two blast-furnaces each 60 feet in height, and 16 feet in diameter at the base, with two casting houses each 92 by 47 feet, two stock houses each 114 by 65 feet, and one engine-room 85 by 50 feet. There is a puddling forge in a building 492 by 83 feet; rolling-mill 421 by 96 feet; a square building containing blowing-room, offices, et cetera, 96 by 96 feet; machine-shop 140 by 57 feet; black-smith-shop 130 by 55 feet; foundry 250 by 57 feet; pattern-shop 85 by 55 feet; tin and plumbing-shop 64 by 55 feet; a building 105 by 55 feet, containing supply store, draughting-room, "duplicates" room, et cetera, and an iron ware-house 167 by 55 feet.

Adjoining the rolling-mill building, is a horse-shoe factory consisting of two buildings respectively 130 and 150 feet in length, and a horse-shoe ware-house 200 by 60 feet. This portion of the works is devoted to the manufacture of the new swaged horse-shoe on machines invented by James A. Burden, for which he obtained a patent in January, 1876. The different departments of these works are connected with each other by railroad tracks over which the material to and from each is hauled by a locomotive owned by the firm, who also own many freight cars. Shipments from the works are made by boats from their wharf, or by railway cars placed on their switch by the railway companies.

In the Upper and Lower Burden Iron Works combined, are sixty puddling furnaces; twenty heating furnaces; fourteen trains of rolls; three rotary squeezers; nine horse-shoe machines, each of which can make sixty horse-shoes a minute; twelve rivet machines, each of which can make eighty boiler rivets a minute; ten large and fifteen small steam-engines; seventy boilers; hook-headed railway spike machinery; and the great water-wheel just described.

The Messrs. Burden own a hematite ore mine in Vermont, and a charcoal blast-furnace in the same State; also an interest in the magnetic ore mine of the Port Henry Iron Ore Company on Lake Champlain, and coal interests in Pennsylvania. The products of their works at Troy, are pig-iron; "H.B. & S." and "Burden's Best" merchant iron; horse and mule-shoes; boiler rivets and railroad spikes.

The capacity of the Burden Iron Works is 40,000 tons of iron annually, not including pig. The bulk of this is converted into horse and mule-shoes, the works having a capacity for making 600,000 casks of 100 pounds each, of horse-shoes a year. They employ 1,400 persons in the establishment.